FOREST HEALTH PROTECTION
Pacific Southwest Region
South Sierra Shared Service Area

38.76267 -120.32578

FHP Report No. C04-3

3420
August 19, 2004

Dwarf Mistletoe Infestation at Sand Flat Campground, Summit Ranger District, Stanislaus National Forest

John Pronos, Plant Pathologist

A walk through Sand Flat Campground on June 21, 2004 revealed a serious infestation of dwarf mistletoe in Jeffrey pine. Present on this visit were Tracy Stelman and Luke Rutten from the Summit Ranger District; plus John Wenz and John Pronos from Forest Health Protection in the Supervisor's Office.

The campground sits at an elevation of 6000 feet and contains 48 campsites. Overstory vegetation is predominantly Jeffrey pine. White fir is also present in the overstory, especially near the Clark Fork. Dominant trees are typically 24" DBH and larger, and 100' or more tall. Understory trees include Jeffrey pine, white fir and a few incense cedar.

Many, but not all, of the Jeffrey pine in this location are infected with western dwarf mistletoe (*Arceuthobium campylopodum*) (The biology of this pathogen is described at the end of the report.). Dwarf mistletoe is affecting all sizes of pines and is contributing to tree mortality within and adjacent to the campground. Trees with Hawksworth dwarf mistletoe ratings of 5 are common. Levels of infection will continue to increase over time and result in additional mortality. Any new natural Jeffrey pine regeneration will eventually be infected. The District should consider a project to reduce the impact and spread of dwarf mistletoe.

DWARF MISTLETOE SUPPRESSION TREATMENTS

A number of treatment methods are available for the suppression of dwarf mistletoe in recreation areas. They can be used singly or in combination. The method or methods chosen for a particular site depend heavily upon the management goals for that site. Stand structure and composition and the intensity of the infection should also be considered. Below is a list of alternative treatments, which FPM can recommend, and guidelines for their implementation. The direct methods are those that can be funded with FPM suppression funds. In keeping with the theme of integrated pest management, these treatments are designed to promote overall stand vigor by suppressing dwarf mistletoe impact.

Direct Suppression Methods

1. Broom Pruning

Objective: To extend tree life and maintain individual treated trees on a site as long as possible.

Guidelines: Remove dwarf mistletoe witches' brooms from high-value trees only if they will have at least 30% live crown after removal of the brooms. This treatment will not eliminate mistletoe from the stand, nor will it prevent future spread. It is most often used in areas that have little or no understory.

2. Tree Removal

Objective: To remove trees expected to die within ten to fifteen years, to prevent the build-up of bark beetles, and to reduce dwarf mistletoe seed in the stand.

Guidelines: Remove trees with a DMR of 5 or 6, or a rating of 4 with mistletoe in the upper one-third of the crown. Such trees generally are not prunable, pose a threat to adjacent uninfected pines, and have a higher probability of dying within 10 to 15 years or during the next drought. It is also advisable to remove infected pines that will have less than 30 percent live crown after pruning, or are growing in dense aggregations where removal of selected individuals would benefit neighboring uninfected or slightly infected pines. Remove all trees having bole infections at a point less than six inches in diameter. Bole infections are not serious from the standpoint of spreading mistletoe, but they deform and/or lead to mortality of small trees and failure of large trees.

3. Creation of Buffer Strips

Objective: To limit or stop the spread of dwarf mistletoe into a treated area from adjacent infested areas.

Guidelines: Use host-free strips to prevent mistletoe from re-entering the control area or, when the parasite is not eliminated, from leaving the site. Buffer strips should be at least as wide as the height of the highest mistletoe plants in the adjacent infested stand. Examples of existing buffers include meadows, roads, rivers, clearings, and aggregations or plantings of non-host trees. Construction of new roads, structures, or campsites can also be used to create buffer zones and eliminate pockets of heavily infected trees.

4. Branch Pruning/Eradication

Objective: To reduce or eliminate dwarf mistletoe seed in the stand and improve tree vigor.

Guidelines: For trees with DMR of 3 or less, or a rating of 4 and no mistletoe in the upper one-third of the crown, prune all lower branches, both healthy and diseased, at the bole up to and including the second whorl of branches above the highest visible mistletoe

infection. Experience has shown that despite removing branches up through the highest infection or even one more whorl, latent infections almost certainly appear in three to five years. Whenever possible, avoid removing more than 50% of a tree's live crown. Pruning of all infected branches in infected trees in an attempt to eradicate this pest requires careful adherence to these guidelines, and will have the greatest chance of success when used on isolated high-value trees or in areas of one acre or less where infection is light. Do not attempt eradication if the pruning will result in a tree with a crown of less than 30%, or if the tree will be exposed to continued infection from adjacent infected trees. It is difficult to completely eliminate dwarf mistletoe from a tree without at least two treatments. Plan to reenter and retreat if needed at least twice after the first entry.

Indirect Suppression Methods

1. Thinning

Objective: To improve stand growth and tree vigor.

Rationale: Despite direct dwarf mistletoe treatment, the benefits from reducing or eliminating infection may be offset by continuing competition for growing space in overcrowded stands. Even where mistletoe is absent, overstocking contributes to poor tree vigor and an unnecessarily high risk of death from bark beetle attack. Although privacy and esthetic requirements in campgrounds may prevent thinning to stocking levels optimum for timber-producing forests, some thinning may be necessary if campground stands are to maintain vigor and resistance to pest attack.

2. Favoring and Planting Non-Host Conifers and Hardwoods

Objective: To eventually replace infected trees with uninfected trees and to lessen future spread of dwarf mistletoe.

Rationale: Because western dwarf mistletoe (*A. campylopodum*) infects neither the hardwoods nor most of the conifers growing with susceptible ponderosa and Jeffrey pines, managers may favor these non-hosts so that they become a larger component of the campground stands. Selected individuals or small aggregations of these non-host species may be retained as buffers to movement of the parasite, or as eventual replacements for severely infected pines that cannot be removed during mistletoe treatment. Wherever there are pure stands of severely infected pines, planting of non-susceptible species may be the only way to ensure that new trees replace the pines that die or are removed. However, for plantings to survive in campgrounds, managers must be prepared to protect them with stakes, fencing, drip irrigation, a visitor information program, and other expensive treatments.

Forest Health Protection can fund dwarf mistletoe suppression projects, but funding is competitive and not guaranteed. Two steps are necessary to complete an effective dwarf mistletoe suppression project. The first is a pre-suppression survey that defines (maps) the area of infestation and records how severely individual trees are infected using the Hawksworth 6-Class Rating System. This information, together with treatment guidelines, is used to estimate what individual tree control methods (e.g. pruning vs. tree removal) will be required. Once this is known the amount of funding needed to complete the second step of the suppression project can be determined. The District can submit one suppression project proposal to cover both of these steps, or it can do each step separately with two project proposals in consecutive fiscal years.

Attached is form FS-3400-2, Forest Health Protection Funding Proposal, that is required for all suppression projects. A production function or economic analysis that shows benefits and costs of the project is also needed. Completed examples of these documents can be provided upon request. Project proposals for FY 2005 are due in the Sonora FHP office by October 1, 2004. Please contact John Pronos [jpronos@fs.fed.us; 532-3671 x242] if you need additional assistance.

Biology of Western Dwarf Mistletoe

Dwarf mistletoes (*Arceuthobium* spp.) are parasitic, flowering plants that can only survive on living conifers in the Pinaceae. They obtain most of their nutrients and all of their water and minerals from their hosts. Western dwarf mistletoe (*A. campylopodum*) infects principally ponderosa, Jeffrey, and knobcone pines, and occasionally Coulter and lodgepole pines.

Dwarf mistletoes spread by means of seed. In the fall the fruit ripen and fall from the aerial shoots. The seeds are forcibly discharged. The seed is covered with a sticky substance and adheres to whatever it contacts. When a seed lands in a host tree crown, it usually sticks to a needle or twig, where it remains throughout the winter. The following spring the seed germinates and penetrates the twig at the base of the needle. For the next 2-4 years, the parasite grows within the host tissues, developing a root-like system within the inner bark and outer sapwood, and causing the twig or branch to swell. Aerial shoots then develop and bear seed in another 2-4 years.

Dispersal of dwarf mistletoe seeds is limited to the distance the seeds travel after being discharged. From overstory to understory, this is usually 20 to 60 feet, but wind may carry them as far as 100 feet from the source. A rule of thumb is that the seeds can travel a horizontal distance equal to the height of the highest plant in an infected tree. There is some evidence that long distance spread of dwarf mistletoe is occasionally vectored by birds and animals.

Vertical spread within tree crowns of most dwarf mistletoes is limited to less than one foot per year because of foliage density. Because of the thin crowns of Digger pine, however, the vertical

rate of spread has been measured as being greater than 2 feet per year. This rate of spread equalled or exceeded the rate of height growth of infected trees.

Dwarf mistletoes are easy to identify because they are generally exposed to view within a tree's crown. Signs of infection include the yellow-green to orange mistletoe plants, basal cups on a branch or stem where the plants were attached, and detached plants on the ground beneath an infected tree. Symptoms include spindle-shaped branch swellings, witches' brooms in the lower crown, and bole swellings.

Growth and Mortality Data: The tables below show how dwarf mistletoes affect ponderosa pines. This data is from Hawksworth, F.G., et. al., "Interim dwarf mistletoe impact modeling system - User's guide and reference manual". USDA Forest Service, Methods Application Group, Fort Collins, CO, Report MAG-91-3, March 1992, 90p.

Table 1. Ten-year growth reductions in ponderosa pine based on Hawksworth mistletoe rating.

HAWKSWORTH MISTLETOE RATING:	**0**	**1**	**2**	**3**	**4**	**5**	**6**
10-YEAR DIAM GROWTH REDUCTION (PERCENT)	0	0	0	2	14	27	50

Table 2. Ten-year mortality percentages for ponderosa pine based on Hawksworth rating and tree size.

HAWKSWORTH MISTLETOE RATING:	**0**	**1**	**2**	**3**	**4**	**5**	**6**
% MORTALITY TREES <9" DBH	0.0	1.2	3.9	8.8	16.O	25.4	37.0
% MORTALITY TREES >9" DBH	0.0	1.0	3.3	7.4	13.3	21.2	30.9

United States Department of Agriculture
Forest Service R5

FOREST HEALTH PROTECTION FUNDING PROPOSAL

Reference FSM 3450

1. Forest Service Region/Area	2. Agency	3. Administrative Unit (Name of National Forest/District, Park, Refuge, Installation, Indian Nation, etc.)	4. State	5. Fiscal Year	6. Condition class (1-3 or n/a)

7. Project Name:	8. Fire Regime (I-V or n/a)

9. Primary Project Objective: (check only one)		10. Proposed Project Is In: (check only one)	
	Protect Threatened/Endangered Species Habitat		Critical Wildlife Habitat
	Eradicate New/ Exotic Insect/Disease Infestation		Urban/Wildland Interface
	Protect Developed Sites/High Value Trees		Non-urban/Wildland interface
	Protect Adjacent Private Land		General Forest Area
	Protect Native Vegetation (forests and trees)		Other
	Other (specify):		

11. Causal Agent(s):

12. Host(s) Protected:

13. No. Acres Proposed:

14. Treatment Method(s):

15. Treatment Material(s) (if applicable):

16. Treatment Rate(s) (if applicable):

17. Project Activities:	Fiscal Year Targets and Costs			
	a. Units of Work (# of acres)		c. Total Cost	
			Federal	state
(1). Pre-Treatment Surveys				
(2). Treatment				
(3). Post-Treatment Evaluation/Monitoring				
(4). Other (NEPA or planning)				
(5). Direct Project Administrative Support				
(6). Carryover				
(7). Total Funding S&PF Funding Requested				

18. Proposed By | Title:

Signature:

Name: | Date:

19. Recommended By | Title:

Name:

Signature: | Date:

20. Brief Description of Project & Remarks:

Form FS-3400-2, R5 revised 07/2004